

IN THE CLAIMS:

Please cancel claims 1 to 17 without prejudice and please replace by inserting new claims 18 to 34, which are attached hereto.

REMARKS

Reconsideration of this patent application is respectfully requested in view of the foregoing amendments and the following remarks.

The amendments to this patent application are as follows. The Specification has been amended on pages 1, 5 and 8 to include the required section headings. The amendments to the claims are to cancel original claims 1 to 17 and to replace these claims with newly added claims 18 to 34. The newly added claims overcome all of the formal objections, because these objected-to terms "such as", "in particular", "preferably", and "characterized in that" have been canceled. Also canceled are the objected-to words "elevated temperature" and "increased pressure," as well as "largely", "further", and "partially".

For all these reasons, all the claims are now in complete compliance with the requirements of 35 U.S.C. 112. Withdrawal of this ground of rejection is respectfully requested.

The Applicants comment upon the prior art rejection of the claims as follows.

The rejection of the claims over prior art overlooks the fact that the object of the present invention is not the formal saponification reaction of PVAc, but rather it is the type of reaction involved, the technical method employed and the resulting products, which are different with respect to their spectrum of properties.

The Ritter WO 96/37544 discloses on the cover page the production of a polyvinyl acetate-based multi-component mixture which is solid at ambient temperature, can be shaped at high temperatures and is in the form of a blend with a filler which is at least partially insoluble in water. According to Ritter, multi-component mixtures of this type with a high degree of waterproofness can be obtained by subjecting polyvinylacetate and at least partially water-soluble alkali silicates (sodium silicate) to the effect of high shear forces in the presence of limited amounts of water at high temperature, intimately mixing the multi-component mixture, and converting at least some of the water-soluble alkali silicate into water-soluble silicate compounds by in-situ chemical reactions. To this end, calcium ion-yielding components in particular can also be used in the charge mixture. The charge mixture is advantageously mixed and the reaction

completed in heated extruders in a continuous process. The resultant extrudate can be shaped immediately although separate re-extrusion with subsequent shaping is also possible. In a variant, the multi-component mixture of the type in question is modified by the additional use of thermoplastic starch which is added to the above process as a preformed valuable substance or even can be formed in situ from starch and plasticizers during the course of this process.

Thus, the patent to Ritter describes the production of a waterproof product from PVAc dispersion and/or powder with sodium silicate by means of extrusion. It is stated that a product that is solid at room temperature in a twin-screw extruder in the temperature interval of 60° to 110°C, has a residence time of the charged mixture in the extruder of between 1 and 5 min. The product can be granulated or ground at elevated temperatures in a shaping manner, so that the product can be used for producing molded articles. It is described there, furthermore, that a chemical reaction takes place during the extrusion, the result thereof is that the acetic acid formed in the reaction effects the formation of waterproof polysilicate structures (Q4-structures). The final product exiting from the extruder is a white strip with a rough surface. It is described therein, furthermore, that the product also may be a combination with starch.

These statements in *Ritter* are respectfully submitted to be contradictory. If the desired saponification reaction would have taken place completely, the product should have a yellowish to brown discoloration due to the formation of byproducts of the hydrolysis. A further indication of an at least incomplete reaction of the sodium silicate, under the described extrusion conditions, is the brown coloration of the starch-containing mixtures with this prior art product. It is known that starch is highly degraded under the influence of alkaline substances acting on it in the course of extrusion, which is consistent with the intensive brown discoloration.

As the result of an experimental reproduction of the procedure set forth in *Ritter*, in an extruder with comparable construction, it was found that contrary to the results stated in *Ritter*, the degree of saponification amounted only to between 10% and 20%. Even raising the temperature to 150°C (analogous to example 2d) did not lead to complete saponification of the polyvinyl acetate, with a residence time of about 5 minutes.

Furthermore, the cited resistance to water of the product due to the formation of Q4-structures of the polysilicates is not necessarily a result of the neutralization of the water glass that occurred during the extrusion procedure. It is known from the literature that in water glasses, when the $\text{Na}_2\text{O}/\text{SiO}_2$ ratio is

shifted and the water content is reduced, predominantly Q3- and Q4-structures of the silicate anions are formed. Due to the addition of powdery water glass (Portil A) to the mixture as described in the *Ritter* patent, and the degassing of the reaction mass taking place during the extrusion, the formation of such condensed polysilicate structures is a compelling result.

Contrary to the teachings of the *Ritter* reference, the present invention describes a clearly different approach leading to a different product and process. In a batch process, a chemical reaction is initiated in the present process by gradually adding the water glass solution dropwise to the mixture heated to the reaction temperature of 120° to 140°C. The result is that detectable composite structures, so-called organo-silicate structures are formed from the polymer component and the SiO₂ of the water glass. Tests have shown that up to 30% of the silicate structures introduced with the water glass is contained in such organic-inorganic composites. Such structures are formed already at degrees of saponification of the PVAc of under 50%, which is clearly below the degrees of saponification specified in the *Ritter* patent.

Another special feature of the novel and nonobvious process of the invention relates to the use of glycerin as the catalyst in the saponification reaction. The glycerin retards the agglomeration

process of the polysilicic acid structures and supports the formation of the described organo-silicates. This leads to a distinctly more finely particulate product as compared to the product made by the method of *Ritter*.

Different products are formed under the conditions described in the respective prior art patents. According to the method disclosed by *Ritter* a product that is waterproof per se is obtained following the extrusion. However, starch-containing mixtures with the product so produced are waterproof only if the starch component in the mixture is maintained below 45%. Therefore, it can be assumed that a covering of the hydrophilic TPS with PVAc and/or polysilicate structures is present in the resulting blend. This is the only manner by which the resistance to water derived from the *Ritter* pre-mixture is transferred to the product of *Ritter*.

Furthermore, the *Ritter* patent provides no teaching that it is possible to produce from the *Ritter* product a thin-walled, blown sheet material. A review of the disclosure contained in the *Ritter* patent reveals no thin-walled blown sheets (<100 μm) possible under the technical procedures of the method described therein.

However, this thin-walled type of product can be produced later from the product manufactured according to the claimed

process. Due to its chemical structure (in particular the existence of organic-inorganic structures) the product of the invention can be readily mixed with hydrophilic-hydrophobic powder and/or granulate mixtures and acts as a compatibility-imparting substance during the extrusion to form a blend. Although the claimed product of the invention has a lower degree of saponification than the one described by Ritter and is present in the extruded mixtures in smaller proportions, the sheets and molded articles produced therefrom are waterproof.

The extruded granulate can be processed to produce either transparent, or opaque, vesicle-free blown and flat sheet materials (sheet thickness 50 to 100 μm), and also to produce injection molded articles. The starch component in the claimed mixtures ranges up to 70%.

The *Maruhashi* secondary reference describes the manufacture of waterproof sheet materials based on PVOH, which is produced according to a process not known, and starch. The sheet itself is cast by pouring it onto a carrier sheet (PET), whereby the patent does not specify any data with respect to the technical process employed for producing the casting compound. The resistance of the sheet materials to water, however, is produced only during the drying step (60° to 100°C) and formation of the melt (150°C to 250°C) by using different cross-linking agents, and at least

uniaxial stretching of the sheet subsequent to the drying step. Thus this patent is therefore not relevant to the claimed invention.

Specifically *Maruhashi* in column 1 in line 5 to 11 discloses a film prepared from a composition comprising a polyvinyl alcohol and a starch or a crosslinking agent in addition to the above two components, and more particularly to a polyvinyl alcohol-starch film having water resistance and being easily degradable due to mechanical actions or microorganisms living in the soil.

In column 2 in lines 43 to 55 *Maruhashi* disclosed that as the polyvinyl alcohol used there can be used not only polyvinyl alcohols obtained by hydrolyzing polyvinyl acetate but also hydrolyzed copolymers of vinyl acetate with another copolymerizable monomer therewith (for instance, an olefin such as ethylene, propylene, butene, α -dodecene or α -octadecene, an unsaturated carboxylic acid such as acrylic acid, crotonic acid, maleic acid or itaconic acid, or its alkyl ester, salt, amide or nitrile, an unsaturated sulfonic acid, and the like) and modified polyvinyl alcohols, e.g., acetalized polyvinyl alcohol or polyvinyl alcohol copolymers.

Beginning in column 3 line 35 through column 4 line 60, *Maruhashi* disclosed that in order to further improve the water

resistance of the film, it is possible to admix the crosslinking agent with the two components mentioned above. Any compounds can be used as the cross linking agent in *Maruhashi* so long as the compound can react with any reactive groups in the polyvinyl alcohol and the starch to intermolecularly form a crosslinked structure. Generally, there are used compounds having a polyfunctional group, capable of reacting with hydroxyl groups in the polyvinyl alcohol and the starch.

Examples of the crosslinking agents used are as follows:

- (1) Polyisocyanate compounds;
- (2) Polyaldehydes;
- (3) Polyepoxy compounds;
- (4) Polyamine compounds;
- (5) Compounds capable of producing a radical;
- (6) Oxidizing agent; and
- (7) Polymerizable monomer.

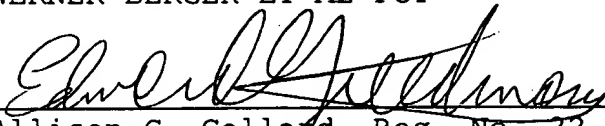
Thus the reaction product produced by *Maruhashi* is entirely different from the claimed invention.

In summary, claims 1 to 17 have been canceled without prejudice and new claims 18 to 34 have been added. In view of these amendments, it is firmly believed that the present invention, and all the claims, are patentable under 35 U.S.C. 103 over all the

prior art applied by the Patent Examiner. A prompt notification of allowability is respectfully requested.

Respectfully submitted,
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Encl.:

1. Four pages of new claims 18 to 34, with cover sheet
2. Amended Pages 1, 5 and 8 of the Specification with cover sheet
3. Marked-up Pages 1, 5 and 8 of the Specification with cover sheet
4. Copy of Petition for One Month Extension of Time for a Small Entity

I hereby certify that this correspondence is being deposited with the U.S. Postal Service as first class mail in an envelope addressed to: Assistant Commissioner of Patents, Washington, D.C. 20231, on February 23, 2001.


Lisa L. Vulpis

VERSION WITH MARKINGS TO
SHOW CHANGES MADE
TO SPECIFICATION

COMPONENT FOR PRODUCING POLYMER MIXTURES BASED ON
STARCH, AND PROCESS FOR PRODUCING THE COMPONENT

Background Of The Invention

1. Field Of The Invention

The invention relates to a component consisting of polyvinyl acetate and alkali water glass for producing thermoplastically deformable, biodegradable and bright polymer mixtures based on starch, with good dimensional stability in water, which can be applied for the manufacture of sheet material, semi-finished and finished products, for example for packagings, containers and articles required in horticultural nurseries, in particular growing or cultivation aids, as well as in other fields of application. The invention, furthermore, relates to a process for producing said component.

2. The Prior Art

Numerous methods have become known in the last few years for producing and shaping thermoplastic starch (TPS) either alone or in the form of a polymer mixture or polymer melt or polymer blend (in the following referred to as a polymer mixture). Said methods were developed with the goal to open up new or expanded fields of application for regrowing raw materials. The basis of all inventions that have become

SUMMARY OF THE INVENTION

Starting with the goal to make even more use of regrowing raw materials for the economical manufacture of products that are compatible with the environment, the present invention developed based on the problem of proposing a component with which it is possible to extrude from thermoplastic starch and a hydrophobic polymer, for example polyvinyl acetate, qualitatively higher valued, thermoplastically moldable and biodegradable polymer mixtures, as well as on the problem of proposing a process for producing said component from polyvinyl acetate and alkali water glass.

The component is obtained according to the invention by hydrolizing and saponifying the polyvinyl acetate in the batch process in the presence of catalytic additions of low-molecular organic mono-, di- and trihydroxyl compounds (e.g. methanol, ethanol, ethylene glycol, glycerol) with a continuous addition of basically reacting compounds and the alkali silicate.

The component contains organosilicates of high homogeneity and fineness consisting of partially saponified polyvinyl acetate and alkali silicate solution, additional

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The various components were produced in a discontinuously operating solid/liquid mixer of the firm Gebrüder Lödige Maschinenbau GmbH. The mixer is equipped with centrifuging gear controllable via the speed (about 350 rpm max.), and with a blade head operating at constant speed. The mixture was heated via the twin jacket of the mixer by means of a pressure-superposed tempering system, or with direct steam.

After the reaction temperature of 120° to 140°C was reached, reaction times of from 1 to 2 hours were required.

The following feed stock was charged: 55% polyvinyl acetate suspension; 99.5% glycerol; 40% Na water glass 37/40; as well as NaOH and/or Ca(OH)_2 .

For determining the quality, polymer mixtures based on polyvinyl acetate and starch each containing 10% of the respective component used were extruded analogous to DE 195 33 800, and test specimens and flat sheets were produced from said polymer mixtures. The mass ratio of starch to polyvinyl acetate amounted to 3:1 in all tests without change.